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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/675,023	09/28/2000	Richard S. Burton	60944.3300	7669

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EXAMINER

LEE, HSIEN MING

ART UNIT	PAPER NUMBER
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2823

DATE MAILED: 03/20/2003

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Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

09/675,023

Applicant(s)

BURTON ET AL.

Examiner

Hsien-Ming Lee

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --
Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 01 January 2003.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-21 and 23-68 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☒ Claim(s) 36-42, 44, 48, 52-54, 57-59, 62, 64 and 68 is/are allowed.
- 6) ☒ Claim(s) 1-9, 11, 12, 14-21, 23, 24, 26, 27, 29-34, 43, 45, 47, 49, 55, 65 and 66 is/are rejected.
- 7) ☒ Claim(s) 10, 13, 25, 28, 35, 46, 50, 51, 56, 60, 61, 63 and 67 is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on _____ is: a) ☐ approved b) ☐ disapproved by the Examiner.
- If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

- 13) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
- ☐ Certified copies of the priority documents have been received.
 - ☐ Certified copies of the priority documents have been received in Application No. _____.
 - ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
- a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

- ☒ Notice of References Cited (PTO-892)
- ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____
- ☐ Interview Summary (PTO-413) Paper No(s) _____
- ☐ Notice of Informal Patent Application (PTO-152)
- ☐ Other:

DETAILED ACTION

Remarks

1. The objection to claims 14, 15, 29, 30 and 65-68; the 112-first-paragraph rejection to claims 1, 21, 34 and 36; the 112-second-paragraph rejection to claims 1, 7, 12, 27, 32, 36, 43-48; 102(b) and 103(a) rejections as set forth in the previous Office action are withdrawn in response to applicants' amendment filed 1/1/03.
2. The rejection to claims 21 and 34, as set forth in the previous Office action, has not been properly responded.
3. Claims 1-21 and 23-68 are pending in the application.

Claim Rejections - 35 USC § 102

4. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

5. Claims 1, 2, 7-9, 12, 19-21, 23, 24, 27, 43, 45, 47, 66 are rejected under 35 U.S.C. 102(b) as being anticipated by Murakami et al. (US 5,747,878).

In re claims 1, 7, 8, 9, 12, 21, 23, 24, 27 and 43, Murakami et al. in Figs 2A-2B and related text expressly teach the claimed method for forming an ohmic contact on a semiconductor layer comprising:

- depositing a reactive layer 12 (i.e. a nickel alloy, NiIn) comprising at least electrically conductive material (i.e. Ni) and an adhesive element (i.e. In) on at least a portion of a

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- compound semiconductor layer 11 (i.e. GaAs); wherein the at least electrically conductive material is chosen from nickel;
 - depositing a refractory layer 13 (i.e. tungsten) comprising electrically conductive material tungsten (W) on the reactive layer 12, wherein said refractory layer 13 (i.e. W) is free of gold; and
- wherein additional layers of conductive metal are not deposited on the refractory layer 13 in the forming of the ohmic contact.

In re claims 2 and 66, Murakami et al. also teach that the compound semiconductor layer comprises N-type $\text{In}_x\text{Ga}_{1-x}\text{As}$ (col. 2, lines 31-33).

In re claims 19 and 20, Murakami et al. also teach that the reactive and refractory layers are formed by chemical vapor deposition (col. 1, lines 65-67).

In re claims 45 and 47, Murakami et al. also teach that the ohmic contact can be used in a field effect transistor. (col.5, line 41)

Claim Rejections - 35 USC § 103

6. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

7. Claims 3-5 and 65 are rejected under 35 U.S.C. 103(a) as being unpatentable over Murakami et al. (US '878) in view of Yagura et al. (US 6,188,137).

Murakami et al. teach that the compound semiconductor layer comprises $\text{In}_x\text{Ga}_{1-x}\text{As}$ but do not expressly teach that the x value is within the range of $0.05 < x < 1.00$ or $0.3 < x < 0.8$ or approximately 0.6.

However, Yagura et al in an analogous art teach utilizing N-type $\text{In}_x\text{Ga}_{1-x}\text{As}$ as the compound semiconductor layer, wherein the x value is within the range of $0.05 < x < 1.00$ or $0.3 < x < 0.8$ or approximately 0.6. (col.3, lines 55-56 and col. 4, line 12).

Therefore, it would have been obvious to one of the ordinary skill in the art at the time the invention was made to use the N-type $\text{In}_x\text{Ga}_{1-x}\text{As}$ having the specific x value, as taught by Yagura et al, in Murakami's method for forming the ohmic contact, since by doing so it would provide a satisfactory ohmic contact structure with low contact resistance (col. 3, lines 14-18, Yagura et al.).

8. Claims 6, 11, 14-18, 26, 29-33 and 41 are rejected under 35 U.S.C. 103(a) as being unpatentable over Murakami et al. (US '878) in view of Uchibori et al. (US 5,982,036).

In re claims 6 and 41, Murakami et al. teach the claimed method for forming the ohmic contact on the compound semiconductor layer comprising GaAs or InGaAs but fail to teach the compound semiconductor layer comprising InAs.

However, Uchibori et al in an analogous art teach forming a multi-layered structure 306/305/304 as the ohmic contact on the InAs layer 303, wherein the multi-layered structure 306/305/304 comprising a Ni film (304), which is formed on the InAs layer 303 (Figs. 4A-4D).

Therefore, it would have been obvious to one of the ordinary skill in the art at the time the invention was made to use the InAs as the compound semiconductor layer as taught by Uchibori et al in Murakami's method so that the reactive layer of Murakami et al. can be formed

on the InAs layer, since by this manner it would benefit the subsequent annealing processing step (col. 8, lines 1-12, Uchibori et al) and obtain the ohmic contact with low contact resistance (Fig. 5, Uchibori et al).

In re claims 14-18, 29-33, the selection of the thickness of the reactive layer as well as the refractory layer is obvious because it is a matter of determining optimum process condition by routine experimentation. In re Jones, 162 USPQ 224 (CCPA 1955)(the selection of optimum ranges within prior art general conditions is obvious) and In re Boesch, 205 USPQ 215 (CCPA 1980)(discovery of optimum value of result effective variable in a known process is obvious). In such a situation, applicants must show that the particular range is critical, generally by showing that the claimed thickness achieves unexpected results. See M.P.E.P. 2144.05 III. In this regard, the as-filed specification does not demonstrate any criticality regarding the claimed thickness range (refers to specification on page 6, lines 11-12).

In re claims 11 and 26, the selection of the atomic percent of the adhesive element is obvious because it is a matter of determining optimum process condition by routine experimentation. In re Jones, 162 USPQ 224 (CCPA 1955)(the selection of optimum ranges within prior art general conditions is obvious) and In re Boesch, 205 USPQ 215 (CCPA 1980)(discovery of optimum value of result effective variable in a known process is obvious). In such a situation, applicants must show that the particular range is critical, generally by showing that the claimed thickness achieves unexpected results. See M.P.E.P. 2144.05 III. In this regard, the originally filed specification does not demonstrate any criticality regarding the claimed range.

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9. Claims 49 and 55 are rejected under 35 U.S.C. 103(a) as being unpatentable over Murakami et al. (US '878) in view of Akiba (US 6,255,679).

Murakami et al. substantially teach the claimed device and method, as stated above, but fail to teach forming a dielectric layer disposed upon the refractory layer.

However, Akiba in an analogous art teach forming a dielectric layer 12 disposed upon the refractory layer 11 (i.e. an ohmic contact layer), wherein the refractory layer 11 is disposed upon a compound semiconductor substrate 4/3/2/1.

Therefore, it would have been obvious to one of the ordinary skill in the art at the time the invention was made to form the dielectric layer, as taught by Akiba, disposed upon the refractory layer of Murakami et al. since by this manner it would provide a base for the subsequent processing for completing a formation of the device as shown in Figs. 2J-2L of Akiba.

Allowable Subject Matter

10. Claim 36-42, 44, 48, 52-54, 57-59, 62, 64, 68 are allowed.

11. Claims 10, 13, 25, 28, 35, 46, 50, 51, 56, 60, 61, 63, 67 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

12. Claim 34 would be allowable if rewritten or amended to overcome the rejection(s) under 35 U.S.C. 112, second paragraph, set forth in the previous Office action.

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13. The following is a statement of reasons for the indication of allowable subject matter:

The prior art of record, Murakami et al. to US 5,747,878, neither teach nor suggest that an adhesive element selected from the group consisting of *chromium, titanium and silicon* (claims 10, 25); the refractory layer comprises *titanium* (claims 13, 28); a *nitride liner* disposed onto a portion of the dielectric layer (claims 50, 56); a *spacer* disposed onto a portion of the nitride liner (claims 51 and 60); depositing a *low sheet resistance layer* onto the refractory (claims 61, 63); and the reactive layer is nickel and an adhesive element and the refractory layer is titanium, wherein the refractory layer is free of gold (claim 44).

Grounds of Rejection

Claim Rejections - 35 USC § 112

14. The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

15. Claims 21 and 34 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

The language “ additional layers of conductive metal are not necessary in the ohmic contact” as recited in claims 21 and 34 is vague because the “**not necessary** in” would raise a doubt whether the “additional layers of conductive metal “ is “ **in** the ohmic contact” or “ **not in** the ohmic contact. “ (emphasis added)

Conclusion

16. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

17. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Hsien-Ming Lee whose telephone number is 703-305-7341. The examiner can normally be reached on M-F (9:00 ~ 5:00).

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Olik Chaudhuri can be reached on 703-306-2794. The fax phone numbers for the organization where this application or proceeding is assigned are 703-308-7722 for regular communications and 703-308-7722 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is 703-308-0956.


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Hsien-Ming Lee
Examiner
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March 12, 2003


Olik Chaudhuri
Supervisory Patent Examiner
Technology Center 2800